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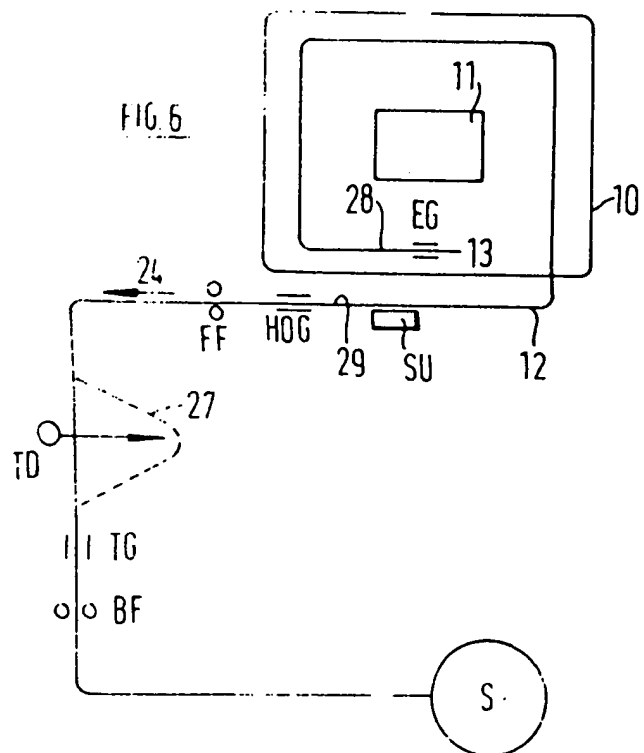
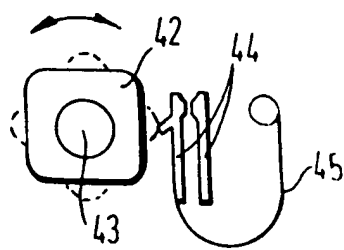
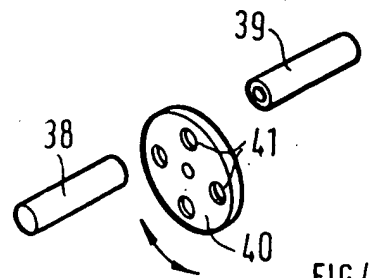
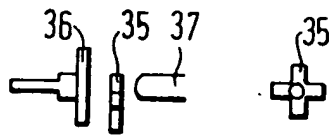
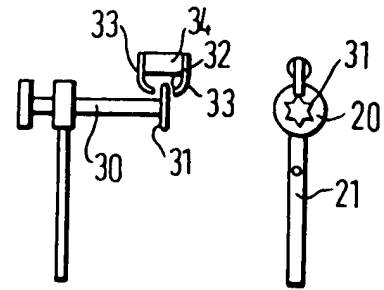
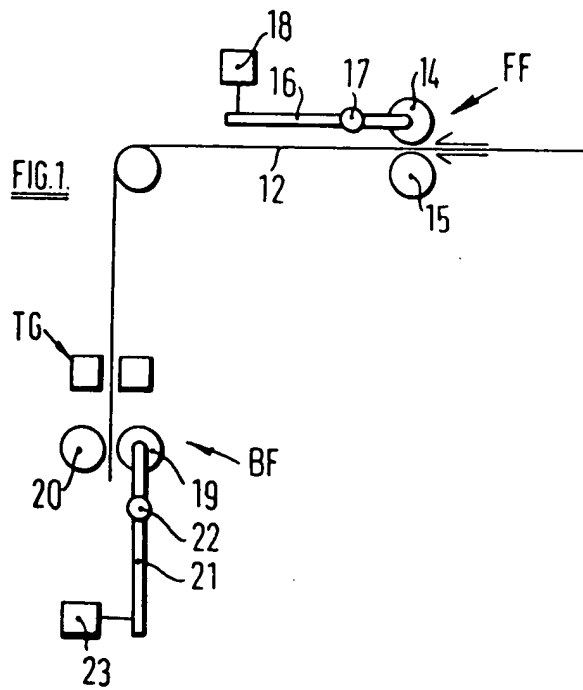
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(54) Feeding Filamentary Material

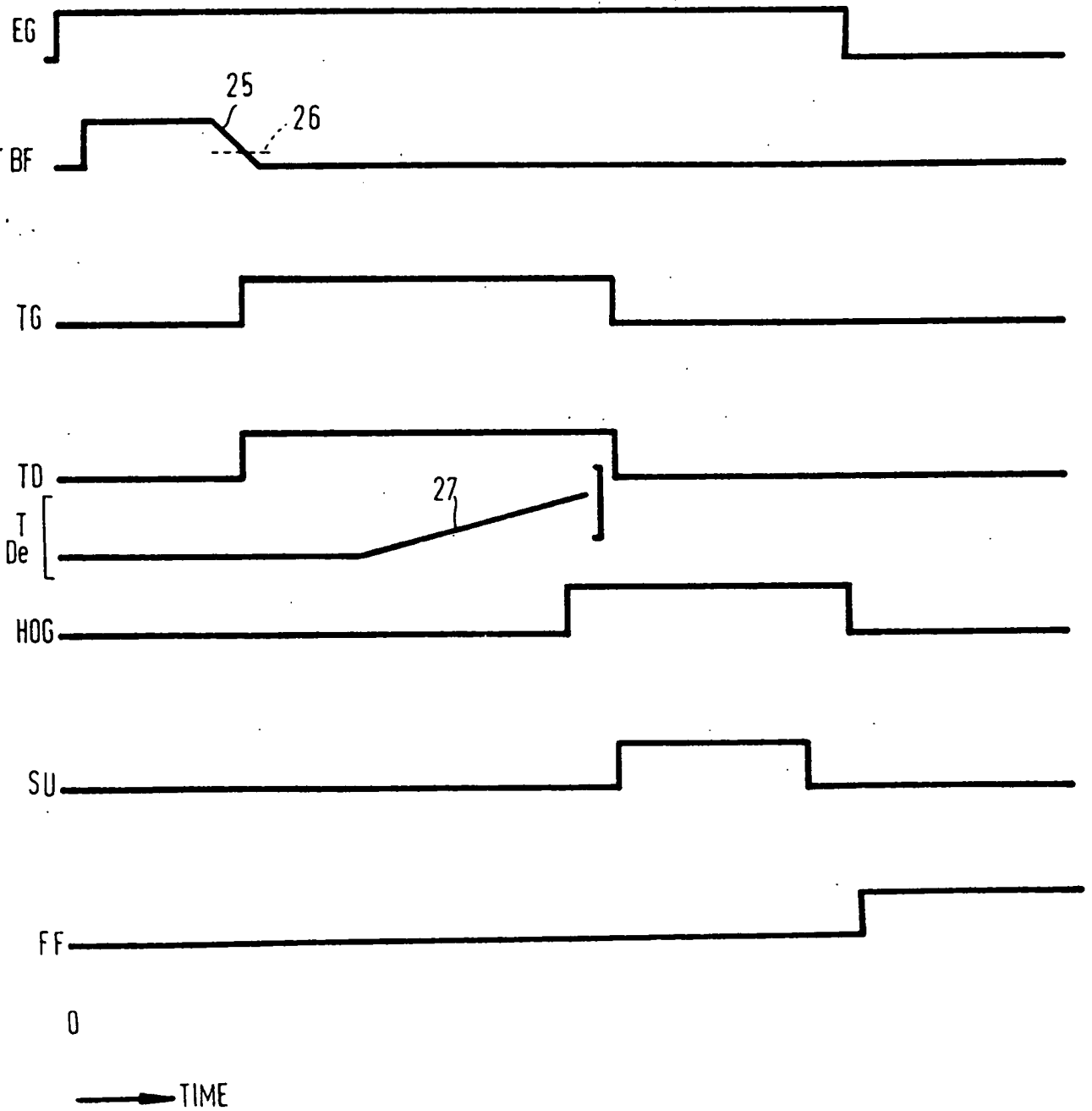
(57) A strapping machine for wrapping filamentary material around a package includes co-operating rotary members for feeding, or back-feeding, the filamentary material and means associated with one of the rotary

members for generating electric pulses indicative of rotation of the member. When the roller associated with the pulse generator is brought to rest, by tightening of the material, a discriminator circuit gives a signal for the next operation in a machine cycle to commence.

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FIG. 7

• SPECIFICATION
Strapping Machines

This invention relates to machines for feeding
filamentary or sheet material. The invention has
5 been developed in relation to strapping machines
of the kind (hereinafter referred to as being of the
kind specified) in which a filament is fed from a
supply around a frame within which is placed a
package to be strapped. The free end of the
10 filament is gripped, the filament is then back-fed
to cause it to embrace the package, then
tensioned about the package and then adjacent
parts of the filament are joined together to
complete a tensioned loop about the package.
15 Before, after, or simultaneously with joining said
adjacent parts of the filament, the filament
forming the loop is severed from the supply. The
filament may be metal wire or plastics strap. If the
filament is wire then the adjacent parts are
20 twisted together. If the filament is a plastics strap
the adjacent parts may be heat-sealed or friction-
welded together. In strapping machines of the
kind specified, the various operations have to be
carried out in the correct sequence. In some
25 instances, one operation has to be completed
before another is initiated. In particular, the free
end of the filament must be gripped before the
filament is back-fed and the back-feeding must be
completed before the filament is tensioned.

30 The feeding and back-feeding are effected by
rotary members which grip and feed the filament.
It is necessary to produce a signal at the end of
the back-feeding and currently strapping
machines of the kind specified use, for this
35 purpose, centrifugal switches, inertia switches,
pneumatic sequencing valves or slipping clutches
with timing devices etc. In particular, inertia
switches rely on a combination of inertia and
friction and are very critical in their operation and
40 have to be re-adjusted every time the speed of
operation of the machine changes. It has been
found that these arrangements are unreliable.
Furthermore, the detection of the end of the back-
feeding and the initiation of the next step in the
45 sequence of the strapping machine are carried out
by two different items of equipment. The
mechanical devices which are used at present are
expensive, since they must be precisely made,
and the speed of operation of the devices is
50 usually the limiting factor in reducing the cycle
time of the machine. Similar problems arise in
other machines in which filamentary or sheet
material is fed or back-fed.

55 It is an object of our aspect of the invention to
provide a machine for feeding and/or back-
feeding filamentary or sheet material and which is
an improvement on those at present in use.

According to this aspect of the invention we
provide a machine including a rotary member for
60 feeding or back-feeding filamentary or sheet
material and means associated with the rotary
member for generating electric pulses, or groups
of pulses, as the member rotates and detector
means for detecting the presence and/or absence

65 of said pulses, or group of pulses, and to provide a
signal for the operation of the machine.

It is an object of another aspect of the present
invention to provide a strapping machine of the
kind specified with reliable means for detecting
70 when an operation of feeding or back-feeding the
filament has been completed.

According to this aspect of the invention we
provide a strapping machine of the kind specified
including a rotary member for feeding and/or
75 back-feeding the filament and means associated
with the rotary member for generating electric
pulses, or groups of pulses, as the member
rotates and detector means for detecting the
presence and/or absence of said pulses or groups
80 of pulses, and to provide a signal for the
continuation of the machine cycle.

Preferably, the pulses, or groups thereof, when
produced act as a "dynamic memory" to provide
e.g., an inhibit signal to prevent the effecting of
85 any further step in the machine sequence until the
detector has detected the absence of the pulses
or groups thereof.

Preferably, said rotary member is one of a pair
of cooperating rotary members and is freely
90 rotatable by engagement with the material to be
fed, e.g. filament, the other member of the pair
being drivable to effect feeding or back-feeding,
the arrangement being such that when feeding or
back-feeding is completed, the one member
95 comes to rest thus providing a signal for the
initiation of further operations of the machine.
Thus while the feeding or back-feeding is being
effected, the rotary member rotates and produces
the pulses or groups thereof. At the termination of
100 the feeding or back-feeding the driven rotary
member will skid on the material and the freely
rotatable rotary member will come to rest thus
terminating the generation of the pulses, or the
groups thereof. This termination of generation is
105 detected and provides the signals for the
operation of the machine, e.g. the continuation of
such operation.

The rotary members of the or each pair may be
relatively movable between operative and
110 inoperative positions. Thus, one of the rotary
members may be mounted on a pivoted arm
operated by a solenoid to move the rotary
member between an operative position in which
the material is gripped between the rotary
115 members and an inoperative position in which the
rotary members are spaced apart to give
clearance to the material.

The generation of the electric pulses may be
produced in any one of a number of ways. In a
120 first arrangement, the rotary member can be
caused to make and break an electrical contact as
it rotates, the frequency of the pulses being of the
order of 100—200 cycles per minute.

In a second arrangement, the rotary member
125 drives an apertured or slotted member between a
light source and a photo-electric cell. The
resistance of the cell will vary depending on the
light allowed to fall on it and will thus produce
pulses when connected in an appropriate circuit.

In a third arrangement, the rotary member drives a toothed disc which varies the inductance of the gap in an electro-magnetic circuit to which a DC voltage is applied, this inductance variation producing the required pulses.

A fourth arrangement is similar to the third arrangement except that a high frequency AC voltage, for example having a frequency of between 20—50 KHz is applied to the electro-magnetic circuit and the rotation of the toothed disc provides a series of groups of pulses instead of a series of single pulses.

In a fifth arrangement, the rotary member drives a slotted or apertured disc interposed between the plates of a capacitor and which varies the capacitance thereof. A high frequency AC voltage is applied to the capacitor and again one obtains a series of groups or pulses.

In any of the above arrangements, conventional circuits will be used to slug the pulses of groups thereof to obtain a reasonably continuous signal and a discriminator circuit will be set at a predetermined level to detect the absence of the pulses or the series thereof.

The invention will now be described in detail by way of example with reference to the accompanying diagrammatic drawings in which:—

Figure 1 is a diagram illustrating the arrangement of feed rollers and backfeed rollers in a strapping machine embodying the invention;

Figures 2 to 5 are diagrams illustrating various means for producing pulses;

Figure 6 is a diagram of the various feed rollers and grippers in a strapping machine embodying the invention;

Figure 7 is a chart showing the sequence of operation of the machine.

Referring first to Figures 1 and 6, the strapping machine comprises a frame 10 within which is located a package 11 to be strapped. A filament 12, which may be metal wire or plastics strapping will, at the end of a previous cycle, have been fed around the frame 10 by forward feed rollers FF until the free end 13 of the filament is detected whereupon the forward feed rollers FF will be disabled. These rollers are shown in Figure 1 at 14 and 15. The roller 15 is driven, by means not shown, and the roller 14 is mounted on an arm 16, pivoted at 17 and movable about the pivot by a solenoid 18. When the rollers 14 and 15 are brought together by the solenoid 18 they grip the filament 12 but when they are moved apart the filament can pass freely between the rollers.

At the end of a preceding cycle, the filament will have been fed as described and if a new cycle is now initiated, the first thing that will happen is that an end gripper EG will grip the free end 13 of the filament. This is indicated by the rise of the line EG in Figure 7 from its datum level at time 0. It will be seen from Figure 7 that at time 0 all the other items of the machine which will be referred to and described below are at their datum levels and are therefore inoperative. Means, not shown, will sense that the end gripper is operative, these

means may, for example, be a switch operated by the end gripper. This passes a signal to activate the back-feed rolls BF shown in Figure 1 and comprising a driven roller, a freely rotatable roller 20, an arm 21 on which the roller 20 is mounted, the arm 21 being pivoted at 22, and a solenoid 23 to operate the arm 21 to bring the back-feed rollers into operative relation to grip the filament 12 or to move them to inoperative relation as described for the forward feed rollers FF. The back-feed rollers are operated by driving the roller 19 with the rollers 19 and 20 in their operative relation and the freely rotatable roller 20 is arranged, as will be described below, to produce a series of electrical pulses or groups of pulses. The result of back-feeding will be to tighten the filament 12 around the package 11, back-feeding moving the filament in the direction of the arrow 24 in Figure 6. The back-feeding will continue until the filament is engaged with the package 11. The rollers 19 and 20 will be incapable of tightening the filament further and the roller 19, although it will continue to rotate, will skid on the filament while the roller 20 will come to rest. The coming of the roller 20 to rest will be detected by a discriminator circuit which has been sensing the pulses. The pulses, or groups thereof, will have been slugged to produce a generally constant signal which will decay as indicated at 25 in Figure 7. At a predetermined point in the decaying signal, indicated by the dotted line 26, the discriminator circuit will give a signal for the next operation to commence.

The next operation is for the tension gripper TG to come on to grip the filament as indicated by the line TG in Figure 7 when the discriminator circuit senses the decay in the signal. The tension gripper having gripped the filament at the position shown in Figure 6, the tension device TD then comes on as indicated by that line in Figure 7 and, as indicated in Figure 6, the filament is tensioned about the package as indicated at 27. The tension in the filament is sensed by a tension-detector (not shown) and the increase in signal in this detector is indicated by the inclined line 27 labelled T Det in Figure 7. When the tension reached a predetermined value, the hold-on gripper HOG comes on as indicated by that line in Figure 7 and grips the filament. The end gripper and the hold-on gripper may be aligned. The sealing unit SU is then operated to unite the overlying parts of the filament indicated at 28 and 29. If the filament is plastics strapping then the sealing unit will weld the overlapping parts 28 and 29 by heat-swelling them or by friction welding. If the filament is a wire then the sealing unit will twist the overlapping parts together.

It will be noted from Figure 7 that when the hold-on gripper has come on, the tension gripper TG and the tensioning device come off. The sealing unit is operated for sufficiently long to provide the seal and then hold-on gripper and end gripper come off as shown in Figure 7. At some state the filament forming the loop is severed from the filament in the supply S. This may be

done before, after, or simultaneously with the sealing of the overlapping filament parts together.

As a final step in the cycle, the forward feed rollers became operative as indicated by the line
5 FF in Figure 7 and feed the filament round until the free end 13 reaches the end gripper as before. It will be seen from Figure 7 that the forward feed rollers FF and back-feed rollers BF are not energised at the same time and the solenoids 18
10 and 23 will be operated accordingly.

As described, it is only the end of the back-feeding which is sensed by the cessation of pulses produced by the back-feeding roller 20. However, if desired, the end of the forward feeding could be
15 sensed by the cessation of pulses produced by the roller 14 during forward feeding. Thus the filament could be caused to come up against an abutment adjacent the end gripper whereupon the roller 15 would skid relative to the filament and the roller 14 would come to rest.

Figures 2 to 5 show various ways in which the pulses, or groups of pulses, can be produced by rotation of the roller 15 or 20.

Referring to Figure 2 the roller 20, mounted on
25 the arm 21 carries a shaft 30 on which is mounted a serrated disc 31. The disc 31 rotates in a gap 32 between the poles 33 of an electro-magnet 34. If a DC voltage is applied to electro-magnet 34, rotation of the serrated disc 31 will
30 provide a series of pulses. If a high frequency alternating voltage is applied to the electro-magnet 34 then rotation of the serrated disc 31 will produce a series of groups of pulses. In either case, the pulses or groups of pulses are produced
35 during back-feeding. When the back-feeding is terminated, the generation of the pulses or groups of pulses ceases and the signal decays as shown at 25 in Figure 7. This is sensed as described and brings on the tension gripper and the remaining
40 steps of operation of the machine.

A similar arrangement could be applied to the forward feed rollers.

In Figure 3, a rotating, cruciform disc 35
45 rotates between a capacitor plate 36 and a probe 37. The rotation of the disc 35 varies the capacitance of the capacitor consisting of the items 35, 36 and 37 and this variation in capacitance is used, via an appropriate circuit, to produce groups of pulses and the operation is as
50 described in relation to Figure 2.

In Figure 4, a light source 38 is directed at a photoelectric cell 39 and an apertured or serrated disc 40 is interposed between the light source and the photo-electric cell. As shown, the disc has
55 apertures 41. The resistance of the photo-electric cell 39 will vary depending on whether light is falling on it or not and these variations in resistance are, through a suitable circuit, caused to produce pulses upon rotation of the roller 20
60 which drives the disc 40.

Figure 5 shows a square cam 42 which is rotated about an axis 43 by the roller 20 and makes and breaks two contacts 44 which are urged together by a spring 45. Once again, as the
65 roller 20 rotates the cam is rotated thus making

and breaking the contacts 44 which will provide pulses. When the pulses stop, the discriminator circuit passes a signal to cause the machine to carry on with its sequence.

70 The signal produced during rotation of the roller 20 during back-feeding may be used to provide an inhibit signal to prevent any further operation of the machine until the pulses cease. In this way, therefore, the generation of the pulses
75 or groups thereof provides a "dynamic" memory. As compared with conventional strapping machines, the feed-detection is cheaper, faster and considerably more reliable.

The invention has been described in detail in relation to a strapping machine. However, the
80 invention can be applied to other machines in which filamentary or strip material is fed and it is required to use the feed or back-feeding, or the cessation of feeding or back-feeding to control the machine.
85

Claims

1. A machine for feeding and/or back-feeding filamentary or sheet material comprising a rotary member for effecting such feeding and/or back-
90 feeding; means associated with said rotary member for generating electric pulses, or groups of pulses, as said member rotates and means for detecting the presence and/or absence of said pulses, or groups of pulses, and to provide a
95 signal for the operation of the machine.

2. A machine as claimed in claim 1 comprising a strapping machine for wrapping filamentary material around a package.

3. A machine as claimed in either one of claims
100 1 or 2 wherein said rotary member is one of a pair of co-operating rotary members and is freely rotatable by engagement with the material to be fed, the other member of the pair being drivable to effect feeding or back-feeding, the
105 arrangement being such that when feeding or back-feeding is completed the one rotary member comes to rest thus providing a signal for the initiation of further operations of the machine.

4. A machine as claimed in claim 3 wherein the
110 rotary members of the or each pair thereof are movable between operative and inoperative positions.

5. A machine as claimed in claim 4 wherein one of said rotary members is mounted on a pivoted arm operated by a solenoid to move the rotary member between an operative position in which the material is gripped between the rotary members and an inoperative position in which the rotary members are spaced apart to give
120 clearance to the material.

6. A machine as claimed in any one of the preceding claims wherein the rotary member is caused to make and break an electrical contact as it rotates to generate the electric pulses or groups
125 of pulses.

7. A machine as claimed in any one of claims 1 to 5 wherein the rotary member drives an apertured or slotted member between a light source and a photo-electric cell, the resistance of

the cell being variable dependant on the light allowed to fall on it and thus producing pulses when connected in an electric circuit.

5 8. A machine as claimed in any one of claims 1 to 5 wherein the rotary member drives a toothed disc for varying the inductance of the gap in an electro-magnetic circuit to which a DC voltage is applied, the inductance variation producing the pulses or groups of pulses.

10 9. A machine as claimed in any of claims 1 to 5 wherein the rotary member drives a toothed disc which varies the inductance of the gap in an electro-magnetic circuit to which an AC voltage is applied, the inductance variation producing a

15 series of groups of pulses.

20 10. A machine as claimed in any one of claims of 1 to 5 wherein the rotary member drives a slotted or apertured disc interposed between the plates of a capacitor and which varies the capacitance thereof, an AC voltage being applied to the capacitor to generate a series of groups of pulses.

25 11. A strapping machine for wrapping filamentary material around a package constructed and arranged substantially as hereinbefore described with reference to and as shown in the accompanying drawings.